Space Weather Technical Forecast

Issued on Tuesday, 28 May 2024 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Ongoing likelihood of further M-class or X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Low with frequent C-class flares. There are ten regions currently on the visible disc, most of which are small and relatively simple. The largest region on the disc is AR3691 in the northeast. This region shows magnetic complexity and contains a broad, albeit weak, delta configuration. AR3697 continues to emerge from the southeast limb, with magnetic looping visible in SDO imagery suggesting that the region extends beyond the limb. Some minimal growth has also been observed elsewhere on the disc including AR3695 in the northeast and the emergence of a small Cso region close to AR3685 and the southwest limb.

No Earth-directed CMEs have been observed, with all previous observed CMEs assessed as missing.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at ACE at L1, were at, or close to, slightly elevated levels initially with speeds of 400-440km/s. Winds eased to background levels around 27/1350 UTC where they have since largely remained and are now around 340 km/s. Density was below average but has increased slightly since 28/0400 UTC to average levels. Interplanetary Magnetic Field (IMF), Bt, was weak between 3-8nT. The north-south component, Bz, also weakly fluctuated, varying between +7nT and -6nT, but favouring a negative (southward) orientation until around 28/0120 after which a more positive (northward) orientation has prevailed. Phi angle was positive (away from the Sun) for much of the period but rotated to be negative (towards the Sun) 27/1800-28/0400 UTC. Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 (greater than 10 MeV) remained at Background. High energy electron flux (greater than 2MeV) at GOES16 varied between Background and Moderate. Associated 24-hour fluence remained steady and below the Active threshold. Observed fluence at 28/00000 UTC was 6.17e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is expected with a likelihood of further M-class flares, and a chance of isolated X-class flares. These most likely from the returning spot ex-AR3664 which has now been numbered AR3697, but also potentially from AR3691 in the northeast.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Solar winds may see a brief enhancement from any fast wind of CH40/+ on Day 1 (28 May) or possibly early Day 2 (29 May). However, only a limited enhancement is likely, with solar winds perhaps reaching 400-450km/s, before easing back to background Day 2 onward. Any enhancement is low confidence, with background winds likely to persist. Mainly Quiet (Kp 0-2) geomagnetic activity expected with Unsettled (Kp 3) intervals, greatest chance on Day 1 should the fast wind arrive.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background throughout, with only a slight chance that any flaring from the current active sunspots will lead to

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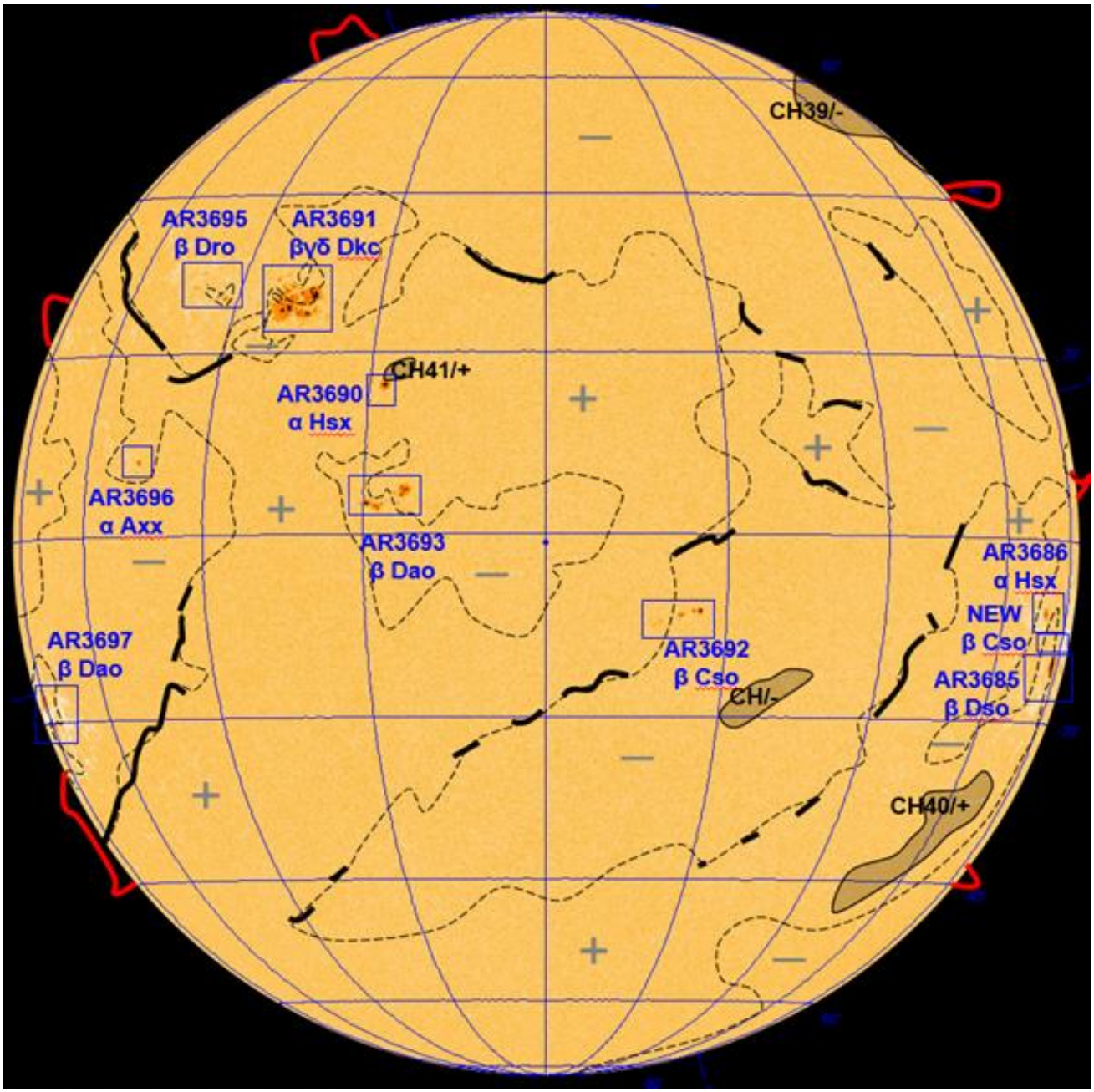
observable high energy protons at Earth, although this probability may increase as the regions rotate onto and across the solar disc. High energy electron flux is also forecast to persist at mainly background, The associated 24 hour fluence is expected to remain below Active.

Figure 1. Solar Analysis Valid 28/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs in the current forecast.

Solar winds are currently background, around 340km/s. The only potential enhancement currently anticipated is associated with the small coronal hole, CH40/+, in the southwest. Later on Day 1 (28 May) or possibly Day 2 (29 May), solar winds may briefly increase to slightly elevated levels around 400-450km/s, before easing to background again Day 2 onward.

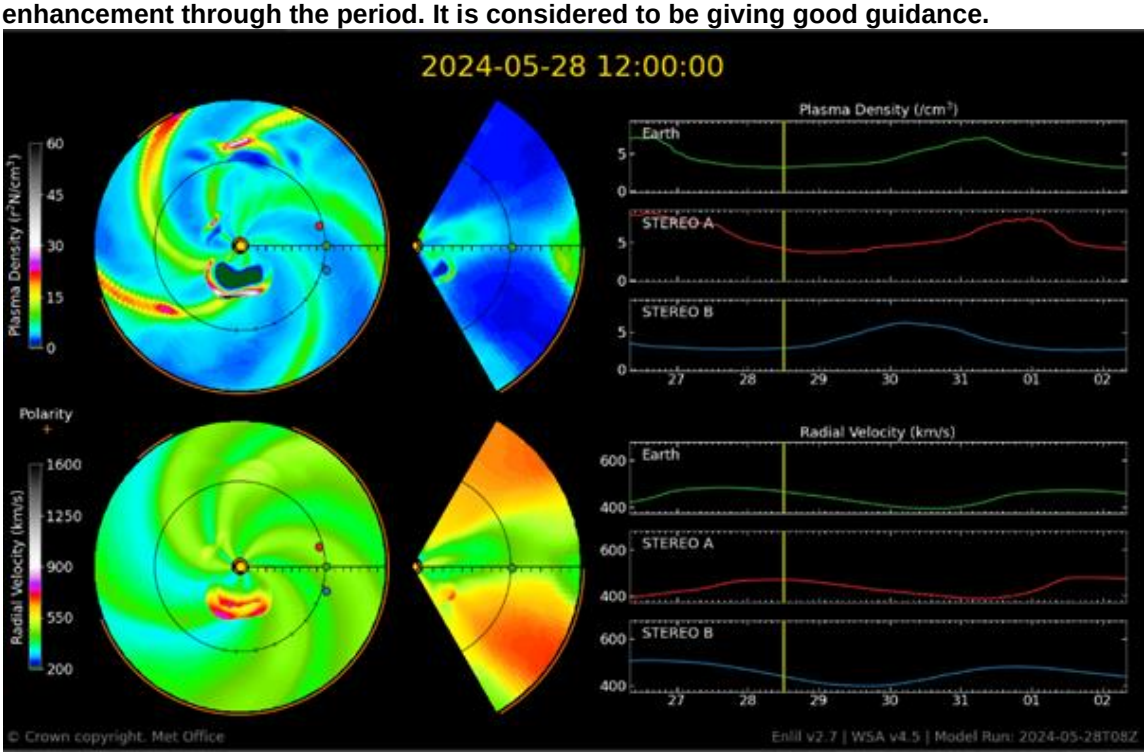
Geomagnetic activity is expected to be mainly Quiet (Kp 0-2), with only a slight chance of Unsettled (Kp 3) intervals and a very slight chance of Active (Kp 4) intervals should connection to a fast wind occur.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No CMEs currently expected.

Figure 2: MOSWOC Enlil showing no expected influence from X2.8 flare on 27 May and no significant enhancement through the period. It is considered to be giving good guidance.



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Radio Blackouts - X-Ray Flares:

Moderate to High activity likely, with the return of ex-AR3664, newly numbered AR3697, onto the southeast limb, along with developing AR3691 in the northeast. Both of these regions produced a significant number of M- and X-class flares on the previous rotation.

AR3697 produced an X-flare on 27 May, while just around the southeast limb, and was the source of at least eleven X-flares on the previous solar rotation. It remains to be seen how much of the sunspot persists from the previous rotation although the helioseismic signature and magnetic looping on SDO imagery would support the idea that much of the region is yet to be fully visible. Accurate analysis of the region may not be possible for another 24-48hours, but the region is currently characterised as Dao/Beta. Given previous and recent activity, further M- or X-class flares are likely.

AR3691 (Dkc/Beta-Gamma-Delta) is the largest region on the disc and also brings a notable flare risk. The magnetic structure shows a N-S configuration, rather than a more typical E-W and the presence of a broad delta region suggests the potential for the region to destabilise and to produce notable flares, including a slight chance of isolated X-flares. The other regions on the disc remain relatively small and simple with only minor growth observed, although a small Cso/Beta region has emerged close to the southwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	75	75	70	70
Very Active	R3 to R5 X Class	No	25	25	20	20

Figure 3: GOES16 & GOES18 X-Ray irradiance trace over past 24-hours

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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently expected to persist at background, with only a slight chance of rising towards the S1 threshold given any further notable flares. These are most likely from either AR3697, which currently straddles the southeastern limb, or AR3691 in the northeast disc. Eastern disc flare locations are much less likely result in an increase to the observed proton flux at Earth, as protons have a tendency to follow the Parker Spiral, away from Earth, however, sufficiently energetic events still have the potential to be observed.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

GOES-16 electron flux is expected to remain mainly at background with brief diurnal increases to Moderate. There is a slight chance of a weak connection to CH40/+ Day 1 or early Day 2 (28-29 May), perhaps suppressing the electron population at GEO on onset, with little enhancement forecast to follow.

The associated 24 hour electron fluence is expected to remain below the Active level, as supported by MOSWOC REFM, which is considered to be giving good guidance for the expected trend through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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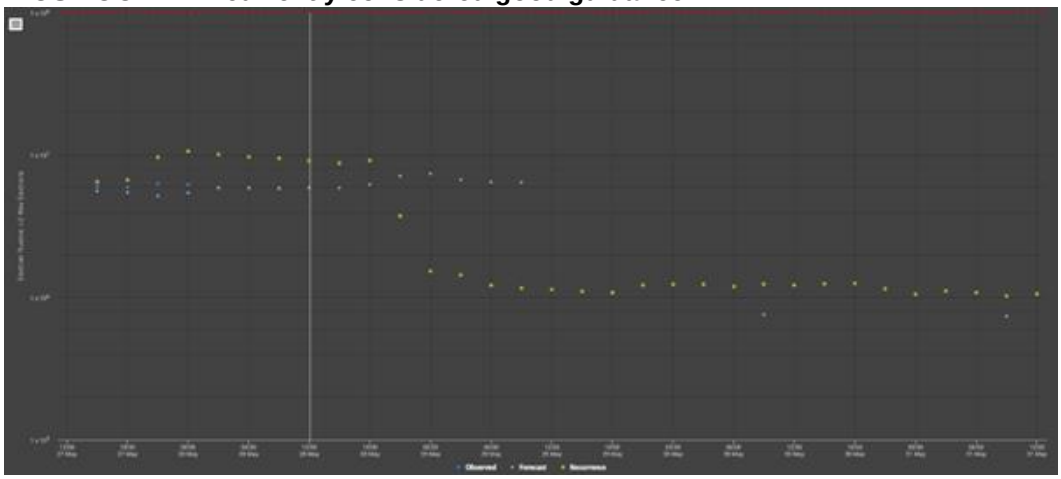
Figure 4: MOSWOC REFM currently considered good guidance.



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